
CHAPTER 4

THE IMPLIED COST OF ENERGY SECURITY THROUGH DOMESTIC OR REGIONAL COAL RESOURCES

The efforts to date to find adequate coal resources in Armenia to support a coal-fired power station have not yet been able to identify adequate coal resources to fire a 50 MW power station. The work so far in all deposits investigated determined that possibly one million tonnes of coal may exist in economically feasible quantities. This is far short of the nine to ten million tonnes necessary for a 50 MW power station over 35 years. Some of the solid-fuel quality found in Armenia is of such a low quality that even larger quantities of coal are necessary to support a power station.

The reality of the energy situation facing Armenia for this domestic fuel strategy is that Armenia must attract financing for both the power station and the mine. Evaluations to date have only considered the cost of developing the power station, which is appropriate, because the capital cost component of the mine is included through a depreciation component in the unit cost of the fuel delivered to the power station. Nonetheless, adequate capital must also be attracted to build both the mine and the power station. Because there is no information upon which to estimate the capital necessary to build a mine, it is difficult to determine what the capital costs might be without having the coal reserve defined. From experience, the cost to develop a mine with adequate capacity could easily range anywhere from \$30 to \$100 million.

Because of the nature of development bank involvement in Armenia, it will be necessary to attract financing from western banks who are willing to risk investment in an Armenian mine and power station. The mine and power stations must be able to economically return a profit that exceeds investment risk levels to attract foreign financing. Thus, these projects must either stand alone and make an adequate profit or they must be subsidized. Given Armenia's current and projected economic woes, it is likely that the projects must stand alone and be profitable in order to attract foreign financing.

4.1 DOMESTIC OPTIONS TO PROVIDE ENERGY SECURITY

Only one option that has not been investigated in detail, Ijevan, remains as the only resource that may produce domestic coal reserves sufficient for an Armenian coal-fired power station. If Ijevan, for whatever reason, can not provide the necessary reserves, then it appears that all possibilities for coal-fired power generation from domestic coal reserves will have been exhausted. The option at that point in time is to review the Dilijan oil shale resource and consider locating a power station near those reserves. If the decision to analyze this shale resource is made, the compatibility of the fuel, given the best available quality information, from

a mining perspective, should be analyzed to first ensure the fuel is satisfactory for the fluidized bed power station.

If domestic coal reserves could be found to provide fuel for a power station, there is an economic cost that must be paid because a coal-fired power station in this region is not the most economic choice for power generation. It is widely accepted that generation of electricity is regionally much cheaper with hydro and natural gas than with coal. Specific studies are necessary for the power station and fuel supply options being analyzed but generally speaking, for a 125 MW power station, a coal-fired power station can cost from \$35 to \$60 million additionally each year in contrast to a gas-fired power station. This information is based upon Hagler Bailly's prior comparative economic analyses conducted in the region and assumes a domestic supplier with a coal quality similar to Armenian coals to a mine-mouth power station.

4.2 REGIONAL OPTIONS TO PROVIDE ENERGY SECURITY

As the Armenian exploration work program appears to be nearing completion and the desire to achieve a greater measure of energy security still exists, it is recommended that a parallel program be initiated at this point in time to continue this quest on a wider horizon. If Armenia simply does not have the coal resources to support a power station of significant size, then one of the next best alternatives remaining is to develop coal resources in nearby countries wherein a reliable supply, market, and economic relationship can be expected. At this point in time, there appears to be only the coal resource at Ijevan that may have the potential to provide the necessary coal for a 50 MW power station. However, Ijevan has difficult geologic conditions that may preclude mineability or the possibility of economic mining.

The search for potential resources should be widened to include nearby foreign coal resources that could potentially provide additional energy security. This program should be initiated while the last investigation into the remaining Armenian coal fields are concluding in order to conserve time and begin evaluating other options. Initially, review of historical production statistics by country should be initiated to determine the capability of established mines or exploited reserves to become a potential supplier. If this level of information does not exist, then the effort would have to begin at the "grass-roots" level of exploration. It is recommended that the exploration team be advised by an independent specialist who can evaluate mining, transportation, and fuel utilization options as the work commences to assist in determining priorities and optimizing the potential for rapid success.

One alternative that is known to exist is the Tkibuli coal mine located in Georgia as discussed in the prior chapter. This resource may provide value because much investment has already been made in the mine and limited capital investment is required in order to re-establish acceptable production capability. Compared to the need to find and develop coal resources in Armenia, this is an attractive possibility. The capital injection required to locate coal reserves, conduct necessary analysis and feasibility studies, and construct a mine with the capacity of the Tkibuli mines in today's economy can easily range from \$100 to \$500 million. The Tkibuli mines

require an investment in the neighborhood of \$20 million to revitalize production. They appear to have the potential of supporting a 150 MW power station. This option could support a larger power station than is currently being considered and may possibly benefit from a higher quality coal if additional beneficiation capital is invested.

If it is assumed the Tkibuli mine produced coal for shipping to Armenia, as discussed in Chapter 3, the lower cost estimate of fuel is projected to be at least \$43 per tonne, FOB power station at Hrazdan. Given this assumption and based on prior regional studies, the annual cost for a 125 MW power station versus a natural gas-fired power station in Armenia will carry an additional economic cost of about \$50 to \$85 million per year. This is the economic cost of providing additional energy independence using a coal-fired 125 MW power station. This unit cost will increase, on a unit power basis, for smaller power stations and decrease for larger facilities. As mentioned in Chapter 3, there are some reasonable options requiring review that could reduce this cost.

The comparatively high economic cost of a coal-fired power station is greatly dependent on the capital investment required for the plant as well as the low calorific content of the coals found so far in this region. If high quality economic coal can be found near Armenia, then the differential economic costs between coal and natural gas-fired power stations will narrow. Nonetheless, as shown above, it appears the most economic alternative for Armenia is to solve the natural gas supply problem in a fashion that provides additional energy security.

Hagler Bailly recommends that the value of developing domestic energy sources be analyzed to determine what annual cost of domestic resource subsidy is acceptable. This information should be used as a guide to determine how this cost will be managed and how future exploration programs should be targeted, rather than spending to explore every possible deposit.